

**AMENDMENT TO SPECIFICATION:**

Please insert the following paragraphs between paragraphs 0031 and 0032 on page 13:

Figure 6 is a simplified schematic diagram illustrating the components for a hardware implementation of a color space conversion scheme in accordance with one embodiment of the invention. Device 146 includes central processing unit (CPU) 110 in communication with display controller 112. Display controller 112 communicates display data to display panel 120, which is also included in device 146. It should be appreciated that device 146 may include any suitable hand-held electronic device having a display panel, e.g., a cellular phone, a personal digital assistant (PDA), a web tablet, etc. In one embodiment, display controller 112 is a liquid crystal display (LCD), which controls a LCD panel. CPU 110 issues read and write commands to display controller 112. Where CPU 110 is associated with color space data having a color space format associated with RGB formatted data, and memory 114 of display controller 112 stores data in a YUV color space format, the data being transmitted between CPU 110 and memory 114 through input port 131 may be converted. Here, color space conversion module 132 is configured to perform the necessary color space conversion scheme.

Color space conversion module 132 may obtain the necessary coefficients in order to apply a conversion equation, from programmable register block 135. In programmable register block 135, the matrix conversion factors, input scaling factors, input offset factors, output scaling factors, and output offset factors are stored in programmable registers within programmable register block 135 as illustrated in Figure 7. Thus, color space conversion module 132 obtains the necessary coefficients from the corresponding programmable register within programmable register block 135. Additionally, data stored within memory 114 of display controller 112 may have a certain color space format, which needs to be converted in order to display on display panel 120. Here, color space conversion module 134 may be used to convert the data from memory 114 in order to format the data for display panel 120.

In another embodiment, display controller 112 of Figure 6, may receive color data from external device 144 rather than from host CPU 110. For example, external device 144 may be a device which provides digital input to display controller 112, e.g., a digital camera, a video decoder, a MPEG decoder, etc. Here again, the color space format associated with external device 144 may be different than the color space format with which display controller 112 operates. Therefore, color space conversion module 132 converts a format associated with the data from external device 144 so that display controller 112 may operate on the data.

Figure 7 is a more detailed illustration of the programmable register block and the color space conversion block of Figure 6 in accordance with one embodiment of the invention. Here, programmable register block 135 includes separate registers for each of the coefficient values from blocks 166, 168, 170, 172 and 174. Three registers are associated with input scaling factors 166 and an additional three registers are associated with input offset factors 168. Conversion matrix 170 includes nine coefficients (3x3), each of which is associated with a register. Output scaling factors 172 and output offset factors 174 each contain three coefficients, which are captured in individual registers, similar to input scaling factors 166 and input offset factors 168. Color space conversion module 160, which corresponds to color space conversion modules 132 and 134 with reference to Figure 6, includes input scaler 176 and input offset block 178. Input offset block 178 feeds into conversion matrix 180, which is in communication with output scaler block 182, which in turn outputs data to output offset block 184. As illustrated in Figure 7, input scaler block 176 is configured as a multiplier, while input offset block 178 is configured as an adder. Similarly, output scaler block 182 is configured as a multiplier while output offset block 184 is configured as an adder. Therefore, color space formatted data represented by input data 186 (A, B, C) is converted through color space conversion module 160 in order to transform input data 186 (A, B, C) to output conversion data 188 in the form of XYZ.

It should be appreciated that the embodiments described herein allow for much more user control of the color space conversion. Furthermore, the

conversion may be defined between various color space formats including but not limited to YUV (or Y'CbCr) to RGB or RGB to YUV (or Y'CbCr) by simply reprogramming the  $X_{\text{subscript}}$ ,  $Y_{\text{subscript}}$ ,  $Z_{\text{subscript}}$  coefficients. As mentioned above, the programmable offset and scale parameters implemented by registers provide additional linear adjustment to the input or output of the CSC block (camera video or JPEG CODEC output adjustment) independent of display frame buffer color look-up table (LUT). In addition, adjusting the LUT requires reprogramming up to 256 registers and affects the entire display. For example, if programmed as a YRC, changes to values Aoff, Boff, and Coff allows brightness and hue manipulation. Changes to Ascale, Bscale, and Cscale allows contrast and saturation manipulation, while changes to values of Xoff, Yoff, Zoff allows RGB color balance manipulation. In one embodiment, the color space matrix output, X, Y or Z, may be fixed to a desired value by programming "0" in the corresponding  $X_{\text{scale}}$ ,  $Y_{\text{scale}}$ , and  $Z_{\text{scale}}$  registers, i.e., for gray scale UV is fixed to 80h. Thus, the CSC X, Y, Z output values could then be fixed to the values programmed in registers Xoff, Yoff or Zoff. In another embodiment, CSC conversion may be bypassed by programming "0" in the matrix register, except for the matrix diagonals  $X_a$ ,  $Y_b$ , and  $Z_c$ , and by programming the Scale Registers, both of which are programmed "1."